BIOTIC COMMUNITIES OF MT. TIMPANOGOS AND WESTERN UINTA MOUNTAINS, UTAH

BY
CHARLES LYNN HAYWARD
B. S., Brigham Young University, 1927
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Scope and Methods of Study

This study includes an analysis of the major biotic communities of Mt. Timpanogos near Provo in the Wasatch Range of Utah and higher elevations of the western Uinta Mountains. The objective was to show the relationships of the communities found there to one another and to other biotic communities of North America. Organisms were studied as far as possible from the standpoint of their distribution, populations, aspections, and interactions.

Observations extended over a period of about 11 years from 1930 to 1941, with the most intensive period of work from 1937 to 1941. The greater part of the studies were made during the summer months. Methods employed included general observations on habits, distribution, etc., and quantitative sampling. Relative numbers of mammals above chipmunk size were estimated by cruising, counting dens, burrows, and other signs, and by counting fecal pellets. Smaller mammal populations were determined by the use of measured plots of one half acre (0.2 hectare) in which were set about 100 snap traps for 4 or 5 consecutive days. No effort was made to calculate influx or efflux so that the data are chiefly of comparative value. Bird populations were made available by cruising over 5 acre (2 hectare) areas in early morning or by watching smaller areas when cruising was not possible. Quantitative invertebrate samples were taken in all layer communities represented. One tenth square meter samples of the upper 2 inches of soil and leaf litter were taken and the invertebrates counted. In the vegetative layers, 48-50 sweeps with a net 30 centimeters in diameter where taken to represent one square meter. Series of specimens of all groups were preserved for identifiication purposes. Daily weather records were kept while the field work was being done.

The general plan of treatment of the subject is to consider the vegetation and the invertebrate animals as a biotic matrix; then the larger animals are treated from the viewpoint of their relationship to this matrix, especially as their life habits are associated with the various layer communities represented. Coactions and reactions of the larger species are brought into the discussion as far as they are understood.

General Summary and Conclusions

I. Topography and geology of the regions are considered particularly with regard to the bearing they have on the biota. Mt. Timpanogos is shown to be an extremely rugged mountain in upper elevations with the result that the Upper Montane forests are able to develop only in scattered subclimax forms. This condition is shown to have a great effect on the population of animals and upon the presence or absence of certain constituents. On the other hand, relatively smooth contours and stable conditions in the high plateau of the Uinta Mountains have allowed the development of extensive Upper Montane climax forests with lower animal populations in general and with a number of true climax animals present.

2. The Montane Coniferous Forests and their seral stages are considered to be a portion of the Transcontinental Coniferous Forest Biome on the basis of a large number of organisms that are common to both and either specifically identical or ecologically equivalent. Presence of these organisms indicates a general similarity in living conditions that binds the northern and montane communities together.

3. Montane and Subalpine forests of Clements, recognized by him as distinct plant formations, are here reduced to associations as a result of including animals in the study. The term "Montane Forest" is used to indicate their close relationship, and they are designated as Lower and Upper Montane largely on the basis of their dominant plants, a few birds, and certain climatic differences. The close biotic relationship between these two communities is indicated by the fact that all the mammals, with the possible exception of one rare mouse,

range through both forest types. There is a tendency for some species to be more abundant in one than in the other but in the case of the larger animals the numbers appear to be about the same. Of about 57 species of birds whose breeding range have been fairly accurately determined, about 61% are known to occur in both Upper and Lower Montane Forests. About 14% are confined to the Lower Montane and 10% to the Upper Montane. The remainder are found in valleys but range through both mountain types. There are also a large number of invertebrates found throughout both Montane Forests.

4. In the Lower Montane, the white fir-Douglas fir climax and the aspen subclimax were studied in more or less detail. The former occurs as relatively small patches on north-facing slopes rather than as a continuous forest. It possesses a luxuriant shrubby and herbaceous growth in some places, but where the tree canopy is dense there is little vegetation on the forest floor. Low shrub-herb, tall shrub, and tree layers were recognized in the vegetation of this community. The aspen subclimax makes up the greater part of the Lower Montane forest on Mt. Timpanogos. There is a general tendency for the aspens to eventually be replaced by conifers, but in many places this is an extremely slow process due, in part at least, to the coactions of the deer, porcupine, and snowshoe rabbit which either kill the trees outright or retard their growth by eating off the terminal shoots. Herb, shrub, and tree layers were recognized in the vegetation of this community.

5. A comparison of the invertebrate populations of the aspen subclimax and the conifer climax of the Lower Montane shows that the total numbers are greater in the aspens in all layer communities. The total invertebrate populations on trees are about 4 times greater in the aspens. In the ground layer ants are very important in both communities, living under logs and rocks as well as in open areas. Many of the species also climb up into the vegetational layers. Beetles and spiders are also an important feature of the ground layer. Leafhoppers are the most abundant invertebrate in the herb and shrub layers of both communities. In the tree layer there is a striking difference in the invertebrate constituents. In the

aspens, leafhoppers of about 4 species comprise about 87% of the total invertebrate population, while in the conifers they form only about 4%. On the other hand, spiders and Diptera are more abundant in the conifers. Spiders make up about 37% of the population in the conifers and less than 1% in the aspens. Diptera form about 50% of the population in conifers and only about 1% in the aspens.

6. All of the larger mammals and birds and many of the smaller ones range through both aspens and conifers. A certain group of hole-nesting birds including several species of woodpeckers, swallows, martins, and house wrens are confined mainly or entirely to aspens; while nuthatches and kinglets are mostly in conifers. The red squirrel (Tamiasciurus) is strictly confiined to the conifers. Gophers and ground squirrels are much more abundant in the aspen forests and seldom enter the climax communities if they are very extensive. Bird populations are higher in the aspens at all seasons except winter.

7. Studies of the Upper Montane forests were carried out in the climax type as it is found in the Uinta Mountains and in the subclimax as found on Mt. Timpanogos. The climax forests consist of dense and extensive stands of Engelmann spruce and alpine fir. The undergrowth is made up of low shrubs and herbs of about the same height and mixed intimately together. There is no tall shrub layer as in the Lower Montane. The Upper Montane forests of Mt. Timpanogos are in the form of a subclimax of scattered Engelmann spruce and alpine fir interspersed with a dense growth of shrubs and herbs. Herb, shrub, and tree layers may be recognized. Continuous climax forests are unable to develop here because of a number of active physical forces including rapid erosion, steepness of slopes, and snowslide action.

8. Invertebrate population studies in these two communities of the Upper Montane, revealed that in most layers the numbers were far greater in the subclimax. Ground populations showed a lower figure in both communities. Ants were less abundant than in the lower Montane. In the herb layer there were about 9 times more invertebrates than in the sub-

climax. This is due to large numbers of leafhoppers of the genus Dikraneura that are present as well as considerable numbers of Hemiptera in the subclimax. The population in trees was about 6 times greater in the subclimax. Leafhoppers were again an important factor. Spiders were more abundant in the climax, but even there were less numerous than in the Lower Montane Climax. Diptera were comparatively more abundant in the climax forests where they made up about 40% of the invertebrate population on herbs and 60% on trees.

9. All of the large vertebrates such as deer and larger carnivors range also into the Upper Montane climax and subclimax as well as many of the earlier seral stages. One mammal, *Phenacomys intermedius*, seems to be confined to the Upper Montane subclimax but it is so rare that this has not been definitely established. About 6 species of birds, including the Rocky Mountain pine grosbeak, Rocky Mountain jay, Clark's nutcracker, and alpine three-toed woodpecker, are confined to the Upper Montane during the breeding season and most of them stay there throughout the year. Marmots and pikas reach their greatest abundance in early xeroseral stages in the Upper Montane but extend down into the Lower Montane as well. The common *Peromyscus maniculatus* is less abundant at higher elevations particularly in early summer. Taking populations of small animals as a whole, plot trapping indicated that the population in the subclimax Upper Montane was about 2.5 times greater than in the climax. This was partly due to late summer increase in the subclimax, possibly resulting from some influx of animals from lower elevations. Bird populations throughout the summer were about 5 times greater in the subclimax than in the climax forests of the Uintas. This high population of vertebrates in the open subclimax type of community characteristic of the upper elevations of Mt. Timpanogos, corresponds with a greater amount and variety and both invertebrate and plant foods, and suggests that food may be the governing factor.

10. Certain mammals and birds appear to be strictly or almost entirely confined to the climax. The marten is quite

rare at the present time but indications are that it is confined to the climax and does not occur in the subclimax of Mt. Timpanogos. The red squirrel seems to require a continuous conifer forest at least an acre in extent. It is rarely found in the Upper Montane of Mt. Timpanogos. The Rocky Mountain jay, alpine three-toed woodpecker, and pine grosbeak are absent from Mt. Timpanogos in summer, yet they are common species in the climax of the Uintas.

11. The mule deer, porcupine and snowshoe rabbit are the larger vertebrates now present in greatest numbers in the Montane Forest. In the aspen subclimax they may be considered as dominants since they effectively control the replacement of the aspens by conifers as already mentioned. In the Lower Montane climax the porcupine is gradually removing the white fir from the community by killing most of the young trees and girdling the larger ones near the top. Nearly all of the predatory mammals are exterminated or so nearly so that they play little part in the community. The only ones of consequence are the badger and coyote which still persist in considerable numbers and feed largely on ground squirrels and pocket gophers during the summer.

12. The Alpine Meadow presents somewhat of a difficult problem and there is still some doubt as to its proper designation. Unlike most of the biomes it consists of small and widely scattered "islands" rather than large continuous areas. Most of the alpine territory is in early seral stages consisting of barren cliffs, talus slopes, or extensive boulder fields. Small ponds and streams also occur and there are often permanent snowbanks. Climax communities develop only in small areas where basins permit the catchment of a little soil. The term "Alpine Meadow" is used in preference to "Petran Tundra" as recently proposed by Clements, since it resembles very little the tundra of the arctic. The climax is composed of sedges and grasses rather than lichens and heath shrubs, and there are no frozen peat beds beneath. Furthermore the influent mammals and most of the birds of the arctic are not present. There are, however, a number of species of plants, a few invertebrates, and one bird (American pipit) common to the north.

Nearly all of the rest of the animals are found also in the Montane Forest seral communities. There are certain resemblances between the Alpine Meadow and lowland grasslands, in that there are many grasshoppers and ants and a number of specifically identical Hemiptera and other insects. Ground squirrels, pocket gophers, and badgers are present as they are in the grasslands although the gophers and squirrels are of different species.

13. Invertebrate populations of the ground layer in the Alpine Meadow are comparatively higher than in the Upper Montane Forests. Mites make up about 40% of the total population and ants form about 14%. The population on herbs is next to the Upper Montane subclimax in abundance, due mostly to large numbers of leafhoppers that compose about 84% of the population.

14. No mammal is confined to the alpine meadow or particularly characteristic of it. Some of the ground dwelling species common to the Montane Forest extend out into it. These include the marmot, ground squirrels, pocket gopher, weasel, skunk (rarely), badger and deer. Peromyscus seems to be absent from it in early summer but moves out onto it in late summer and autumn. Microtus has not as yet been found on the alpine meadows of Mt. Timpanogos. The pika is confined mostly to loose rock piles but feeds to some extent on the alpine meadows. Pipits nest in the alpine climax but the rosy finch is found mostly about loose rock piles or on cliffs. Neither of these birds remains in the alpine region during the winter. The ptarmigan, which is confined to the alpine in many parts of the Rocky Mountains is absent from Mt. Timpanogos. Bird populations are very low in the Alpine Meadow except in autumn when occasional flocks of mountain bluebirds and several species of sparrows feed on grasshoppers and other invertebrate inhabitants.

15. The chaparral, which occurs immediately below the Montane Forest, is here considered as an ecotone rather than a distinct formation as proposed by Clements under the term "Petran Chaparral." Even though the community presents a distinct life form due mainly to the presence of scrub oak on

Mt. Timpanogos and vicinity, this condition does not prevail over large areas. In many places elsewhere the yellow pine extends into it as a kind of parkland, and in other areas the oakbrush is absent entirely, being replaced by a mixture of low valley shrubs and Montane Forest trees. Even in the area studied, the plant constituents are about half valley grassland and half montane. The mammal population is made up of a mixture of montane and lowland species. About 4 species of birds are confined to it during the nesting season in the area studied and the rest are either lowland or montane species.

16. Probably the most striking feature of the invertebrate population of the chaparral is the large number of parasitic Hymenoptera. A number of these form galls on oak leaves or twigs and others live as inquilines in such galls.

17. The chaparral is the principal winter home of the deer. This animal feeds mostly on cliff rose and mahogany which occur on some of the earlier stages of the rock sere. However, they also feed to some extent on the acorns and twigs of oakbrush. Coactions of deer on mahogany are very evident from the high-lines seen in many places. The porcupine also extends out into the chaparral and feeds on the bark of oakbrush and other shrubs in winter.

18. Among the birds of the chaparral the spurred towhee, green-tailed towhee, Wright's flycatcher, and Virginia's warbler, appear to be confined to it during the nesting season, but this condition may not prevail generally in other localities. Since snow does not ordinarily cover the ground for very long periods, the chaparral is an important feeding area for large numbers of small wintering birds. Many of the grassland reptiles including the rattlesnake, blowsnake and a number of species of lizards reach their altitudinal limits in the chaparral ecotone.

19. General observations were made on the seral development of the communities, but no quantitative data are available for the earlier stages. In general it may be said that the development of communities in mountains is an extremely slow process due to the great activity of physical forces and the short periods of growth and activity. In stabilizing com-

munities, organisms have great obstacles to overcome in the way of physical and biotic retarding forces and comparatively little time to do it in.

20. Some data were gathered on the seasonal and cyclic activities, particularly of the larger animals. The only mammal, other than some bats, to show definite migratory activities is the mule deer. This animal moves down into the chaparral in winter and up into the Montane Forests in summer. These movements are in the form of scattered drifting rather than mass movements and tend to fluctuate in time depending upon the accumulation and persistence of snow. Birds show a number of seasonal shifts of considerable importance. Following the nesting season there is a general up-mountain shift of a number of species that breed at lower elevations, so that the late summer populations tend to increase at higher and decrease at lower elevations. In addition to birds that migrate south in winter a number of species move down the mountain and show somewhat different habitat relations than they have in summer. Wintering birds in the chaparral also include a number of species that move in from further north.

VITA

Charles Lynn Hayward was born July 16, 1903, at Paris, Bear Lake County, Idaho. He was graduated from the Fielding High School in that town in 1923. His undergraduate college training was obtained at Brigham Young University, Provo, Utah, from which institution he was graduated with a B. S. degree in 1927. For three years he taught biology at Fielding High School, Paris, Idaho, and then returned to Brigham Young University as assistant in zoology. In 1931 he was awarded an M. S. degree from that institution and made an instructor in zoology there the same year. Further graduate studies included a year at the University of California, six weeks at the Hopkins Marine Station, Pacific Grove, California, and a year and a half at the University of Illinois in 1938-39 and 1941. In 1939 he was made assistant professor of zoology at Brigham Young University, which position he holds at present.

He is a member of the Illinois chapter of Sigma Xi and of the Brigham Young University chapter of Beta Beta Beta. He also holds membership in the Ecological Society of America, American Society of Mammalogists, American Ornithologists Union, and the Utah Academy of Sciences, Arts, and Letters.

A list of Mr. Hayward's scientific papers is as follows:

1930. Notes on Utah Vespidae. Ent. News, 41: pp. 205-206, 222-226.

1931. A preliminary list of the birds of the sub-alpine and alpine zones of the Uintah Mountains. Utah Academy of Science, 8: pp. 151-152.

1932. The paper wasps of Utah including a description of a new variety of *Polistes canadensis* Linn. Proc. Utah Acad. Sci., 9: pp. 85-101.

1933. Notes on the taxonomy and distribution of the wasp genus Polistes in the intermountain West, with descriptions of two new varieties. Proc. Utah Acad. Sci., 10: pp. 139-147.

1933. Distribution of Polistes in Canada, with notes on the genus. Canadian Entomologist, 65, pp. 126-128.

1934. Important heron rookeries in southeastern Idaho. Auk, 51: pp. 39-41.

1935. Breeding status and migration of the Caspian tern in Utah. Condor, 37: pp. 140-144.

1935. Observations on some breeding birds of Mt. Timpanogos, Utah. Wilson Bull., 47: pp. 161-162.
1935. A study of the winter bird life in Bear Lake and Utah Lake valleys. Wilson Bull., 47: pp. 278-284.
1936. Some observations on the shore birds at Utah Lake during the summer of 1936. Proc. Utah Acad. Sci., 13: pp. 191-193.
1936. A bibliography of Utah mammalogy; including references to names and type localities applied to Utah mammals. Proc. Utah Acad. Sci., 13: pp. 121-146.
1937. A record of *Vespa crabro* Linneaus from North Dakota. Ent. News, 48: pp. 303-305.
1937. Some new and unusual bird records from Utah. Wilson Bull., 49: pp. 303-305.
1940. Notes on the distribution of nighthawks in Utah. Great Basin Nat., 1: pp. 93-96.
1940. Feeding habits of the red squirrel. Jour. of Mammal., 21: pp. 220.
1941. Notes on the nesting habits of some mountain dwelling birds in Utah. Great Basin Nat., 2: pp. 1-8.